

**U.S. Department of the Interior
U.S. Geological Survey**

**FISH-COMMUNITY COMPOSITION IN MILL CREEK, CROOKED
CREEK, AND TIOGA RIVER IN THE VICINITY OF TIOGA-HAMMOND
DAMS, TIOGA COUNTY, PENNSYLVANIA, 1998**

by Robin A. Brightbill and Michael D. Bilger

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BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY

Charles G. Groat, Director

For additional information
write to:

District Chief
U.S. Geological Survey
840 Market Street
Lemoyne, Pennsylvania 17043-1586

Copies of this report may be
purchased from:

U.S. Geological Survey
Branch of Information Services
Box 25286, Federal Center
Denver, Colorado 80225-0286

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CONVERSION FACTORS AND ABBREVIATIONS

<u>Multiply</u>	<u>By</u>	<u>To obtain</u>
Length		
millimeter (mm)	0.03937	inch
meter (m)	3.281	foot
kilometer (km)	0.3861	mile
Area		
square meter (m ²)	10.76	square foot
square kilometer (km ²)	0.3861	square mile
Mass		
gram (g)	0.03527	ounce, avoirdupois
Temperature		
degree Fahrenheit (F)	°F=1.8 °C+32	degree Celsius

Abbreviated water-quality units used in report:

μS/cm, microsiemens per centimeter at 25 degrees Celsius

Fish-Community Composition in Mill Creek, Crooked Creek, and Tioga River in the Vicinity of Tioga-Hammond Dams, Tioga County, Pennsylvania, 1998

by Robin A. Brightbill and Michael D. Bilger

ABSTRACT

The U.S. Army Corps of Engineers, Baltimore District, has been conducting biological surveys of the inflow and outflow streams of Tioga-Hammond Reservoirs since the early 1980's. These surveys are made to identify possible detrimental effects as well as benefits of the reservoirs and to better understand the aquatic communities in the vicinity of the reservoirs at the present and over time. The U.S. Army Corps of Engineers and the U.S. Geological Survey jointly conducted a survey of the fish communities at Mill Creek near Mansfield, Pa. (inflow), Crooked Creek near Crooked Creek, Pa. (inflow), Crooked Creek near Tioga, Pa. (outflow), Tioga River at Tioga, Pa. (outflow), Tioga River near Tioga Junction, Pa. (outflow), and Tioga River at Lindley, N.Y. (outflow), in September 1998. The fish communities at sites above and below the Tioga-Hammond Dams were compared and any differences or similarities seen in the fish communities at the sites listed were noted.

This study found the fish communities upstream and downstream of the reservoir to be in fair to good condition; the Index of Biotic Integrity (IBI) scores ranged from 3.5 to 4.7. The habitat conditions upstream and downstream were of sub-optimal quality, with scores ranging from 14 to 15, according to the U.S. Environmental Protection Agency's Rapid Bioassessment Protocols, yet are still capable of supporting fish communities. The Shannon Index of species richness and evenness ranged from 2.56 to 3.75. Only Mill Creek was statistically different from the two Crooked Creek and three Tioga River sites using Jaccards Coefficient and the Index of Similarity. The Crooked Creek and Tioga River sites were determined to be statistically similar using these same two methods.

INTRODUCTION

Biological surveys of streams in the vicinity of selected reservoirs were initiated in 1982 by the Baltimore District, U.S. Army Corps of Engineers (COE). The principal objective of the surveys is to identify possible detrimental effects as well as benefits of the reservoirs, add to a database that was developed for monitoring the composition, abundance, diversity, and distribution of fishes over time, and provide a better understanding of the aquatic resources in the vicinity of the reservoirs. The fish communities at the inflow and outflow of the Tioga-Hammond Dams were surveyed on September 14, 17, 21-24, 1998.

The study was a joint effort between the COE and the U.S. Geological Survey (USGS). An assessment of the habitat suitability for sustaining fish communities also was included in this study. The fish communities were sampled to determine their structure and health and any differences that may exist upstream and downstream of the dam.

DESCRIPTION OF DAMS AND STREAM STUDY REACHES

The Tioga and Hammond Dams were completed in 1979 for the purpose of flood control in the Chemung River (U.S. Army Corps of Engineers, 1999). The lakes formed by the dammed water are connected by a weir for the purpose of mixing the alkaline water of Crooked Creek with the more acidic water of the Tioga River. This mixing will raise the pH of the waters that are released through multi-level outlets into the downstream part of the Tioga River. Water from Hammond Lake also is released into the downstream part of Crooked Creek (Ward, 1976).

Stream reaches were selected to correspond with existing COE macroinvertebrate reaches and previously sampled fish-community reaches. Each reach was a minimum of 100 m (330 ft) in length and included a proportional representation of the available geomorphologic units for the stream—riffle, run, or pool.

Six reaches, two upstream and four downstream of the Tioga and Hammond Dams, were chosen for the fish-community study (fig. 1). The two upstream reaches are Mill Creek near Mansfield, Pa. (latitude/longitude = 41°52'24"/77°05'03"), upstream of Tioga Reservoir, and Crooked Creek near Crooked Creek, Pa. (latitude/longitude = 41°52'21"/77°12'30"), upstream of Hammond Reservoir. The four downstream reaches are Crooked Creek near Tioga, Pa. (latitude/longitude = 41°54'32"/77°08'27"), downstream of Hammond Reservoir, Tioga River at Tioga, Pa. (latitude/longitude = 41°54'37"/77°07'48"), downstream of Tioga Reservoir, Tioga River near Tioga Junction, Pa. (latitude/longitude = 41°57'26"/77°06'56"), downstream of the confluence with Crooked Creek, and Tioga River at Lindley, N.Y. (latitude/longitude = 42°01'23"/77°07'53"), downstream of the confluence with Crooked Creek and Cowanesque River (fig. 1).

Mill Creek near Mansfield is upstream of Tioga Reservoir. The reach begins approximately 1.3 km (0.8 mi) upstream from where the creek flows into the State Game Lands No. 37 and extends upstream 105 m (344 ft). The drainage area is 186 km² (72 mi²). The approximate area sampled was 1,384 m² (14,947 ft²). The geomorphic channel unit was riffle and pool, and bottom material was bedrock, cobble, and boulder. The downstream pool had a bedrock bottom, and the left bank was a bedrock ledge that extended to the edge of the forest. The right bank was a thin riparian zone capped by the road. The riffle and upper pool had a bottom substrate of cobble and gravel. The left bank was linear, gently sloping upward from the stream with cobble and little vegetation; the right bank was almost vertical and approximately 2 m (6 ft) high.

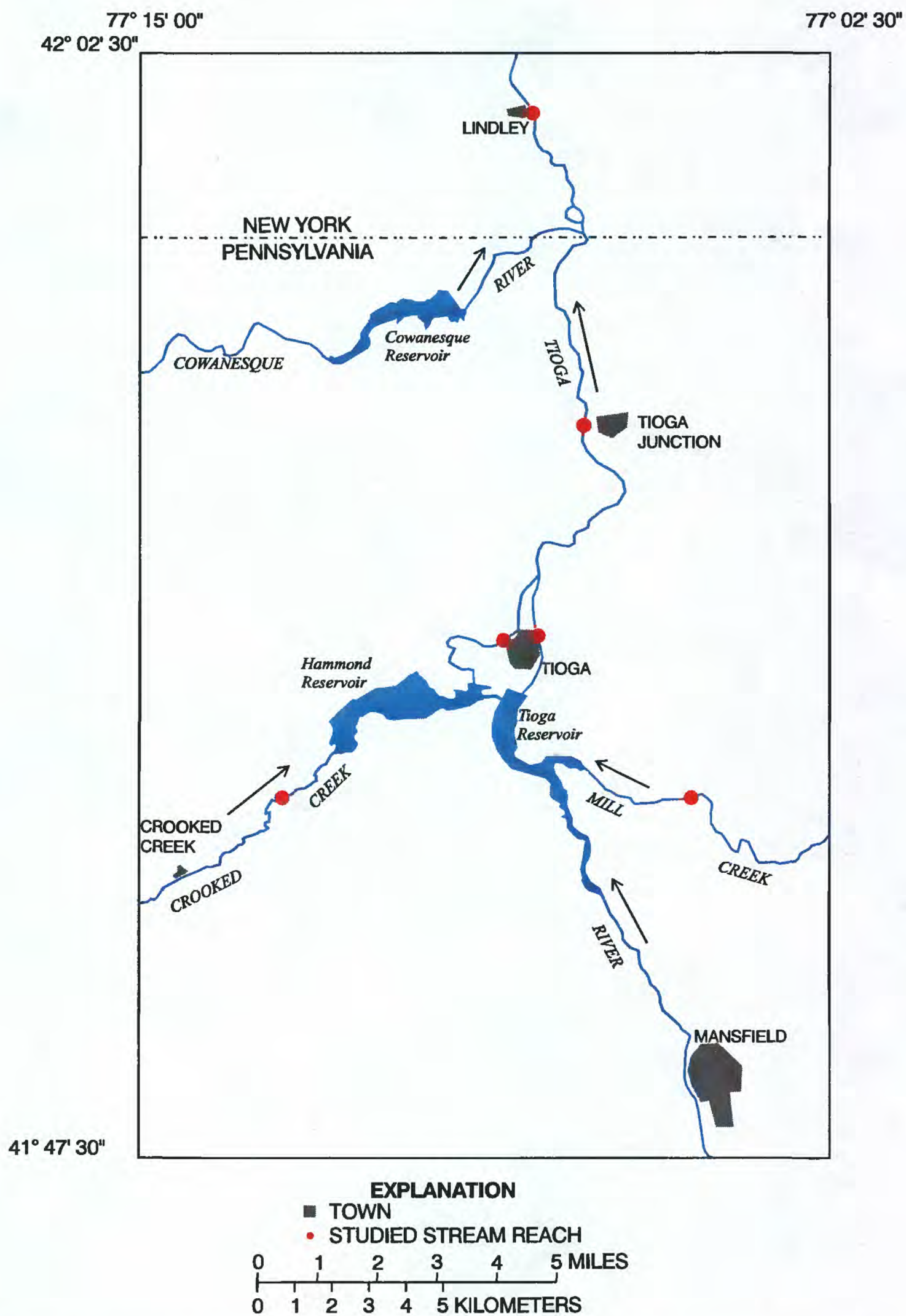


Figure 1. Site location of reaches sampled for fish communities upstream and downstream of the Tioga and Hammond Dams, Pa., 1998.

Crooked Creek near Crooked Creek is upstream of Hammond Reservoir. The reach begins approximately 1.6 km (1 mi) upstream of the confluence with Stephenhouse Run and continues upstream 143 m (471 ft). The drainage area is 274 km² (106 mi²), and the approximate area sampled was 1,894 m² (20,455 ft²). The geomorphic channel unit was riffle and pool; the bottom material was cobble and gravel. The right bank was a gently sloping, linear, gravel area near the lower riffle. Upstream of the riffle was a pool too deep to backpack electroshock. The right bank in the area of the pool was a cliff. The left bank was linear and gravel throughout the entire reach and similar to the lower right bank. The riparian zone around the creek was forested.

Crooked Creek near Tioga is downstream of Hammond Dam. The reach begins 0.32 km (0.2 mi) upstream of the SR 1030 bridge in Tioga and extends upstream for 150 m (480 ft). The drainage area is 339 km² (131 mi²). The approximate area sampled was 936 m² (10,108 ft²). The geomorphic channel unit of the reach was riffle and run with a pool at the top of the reach. The right bank at the pooled area was a gravel shoal transitioning into a grassy floodplain. The right and left banks near the riffle and run areas were gently sloping linear banks with a thin riparian zone giving way to mowed yards.

Tioga River at Tioga is approximately 1.5 km (1 mi) downstream of Tioga Dam. The reach begins 0.32 km (0.2 mi) downstream of the streamflow-gaging station and extends upstream 205 m (656 ft). The drainage area is 730 km² (282 mi²). The approximate area sampled was 6,650 m² (71,820 ft²). The geomorphic channel unit was riffle, run, and pool, and the bottom material was cobble and gravel. This reach had manganese, iron, and aluminum precipitate coating the stream bottom. The right bank was gently sloping and linear. The river flows along the bottom edge of a mountain ridge that is part of State Game Lands No. 37. The left bank was linear and extended into the flood-control wall.

Tioga River near Tioga Junction is approximately 8.5 km (5.5 mi) downstream of the dam. The reach begins 118 m (389 ft) downstream of the Route 328 bridge and extends upstream to the bridge. The drainage area is 1,157 km² (447 mi²). The approximate sampling area was 2,080 m² (22,464 ft²). The geomorphic channel unit was riffle, run, and pool, and bottom material was cobble and gravel. The channel was braided. The first island covered an area approximately 1 m² (11 ft²), a second island an area approximately 1,680 m² (18,144 ft²), and a third island an area approximately 780 m² (8,450 ft²). The banks were gently sloping and linear with a thin riparian zone giving way to uncultivated fields. The right bank downstream of the islands was deeply undercut.

Tioga River at Lindley is approximately 14.5 km (9 mi) downstream of the dam and is the most downstream reach sampled. The reach begins approximately 640 m (2,100 ft) upstream of the Tioga River at Lindley streamflow-gaging station and extends upstream another 201 m (660 ft). The gaging station is located just downstream of the County Highway 120 bridge. The drainage area is 1,997 km² (771 mi²). The approximate sampling area was 4,020 m² (43,416 ft²). The geomorphic channel unit was riffle and pool, and the bottom material was cobble and gravel. The right edge of water had some woody snags in the upper pool, and the bank was a gently sloping, linear, gravel shoal that transitioned into the bottom edge of a ridge. A slough and some backwater were near the lower riffle areas. The left bank was steep, wooded, and capped by the road.

STUDY METHODS

The fish communities in the vicinity of the Tioga-Hammond Dams were surveyed between September 14 and 24, 1998. These communities were characterized by total number of species collected and each species relative abundance. Habitat was assessed and related to the fish communities present in each stream reach.

Fish Sampling

All six reaches were wadable. A Coffelt Mark-10 backpack electroshocker incorporating pulsed DC was used at each sampling reach. Mill Creek and both Crooked Creek reaches were covered with a single pass in an upstream direction. Crew size consisted of four individuals at Mill Creek (shock time of 3,036 seconds) and the upstream reach of Crooked Creek (shock time of 4,086 seconds), and five individuals at the downstream Crooked Creek reach (shock time of 4,895 seconds). To cover the Tioga River reaches, two passes were conducted in an upstream direction with a crew size of five individuals. Shock times for Tioga River sites ranged from 7,181 to 7,885 seconds. The backpack electroshocker, an electrode, and a net were carried by one person. The other individuals on the crew netted the fish and put them in buckets.

After each pass, the captured fish were placed into rubber tubs with aerators, sorted, and identified to species using regional texts to confirm identifications (Page and Burr, 1991; Smith, 1985). A maximum of 25 individuals per species were weighed (grams), measured for total and standard lengths (millimeters), and examined for external anomalies (Meador and others, 1993). After 25 individuals of a species were weighed and measured, the remaining fish were counted and mass weighed to the nearest gram. A summary of the fish data can be found in the appendix. A few specimens were put into 10 percent buffered formaldehyde for a voucher collection and verification in the USGS laboratory in Lemoyne, Pa. Fish from the single-pass reaches were released directly back to the stream. Fish from the two-pass reaches were placed in a live cage away from the reach being shocked to prevent further trauma. After both passes were completed, the fish were released back into the stream.

Habitat Quantification

Habitat assessment was conducted according to the Rapid Bioassessment Protocols (RBP) (Barbour and others, 1997). The riffle and run prevalence data form was used. Twelve criteria were used to assess the quality of the fish habitat. Each criterion is rated on a score of 1 to 20. These scores were summed for a total habitat score. An average was then calculated and assessment was made on this averaged score. A score of 0-5 is poor, 6-10 is marginal, 11-15 is suboptimal, and 16-20 is optimal (Klemm and Lazorchak, 1995). A reach with a higher habitat score should, theoretically, support a healthier fish community than a reach with a lower habitat score.

Data Analysis

The numbers of fish and their weights were totaled by species. The catch-per-unit-effort (CPUE) was calculated by dividing the number of fish collected by the total electroshocking time (Nielsen and Johnson, 1983). CPUE was used to compare the number of fish collected at each reach for the amount of time used for the effort. A higher CPUE would show more fish in an area than a lower CPUE. The reach with the lower CPUE is typically considered to be more impaired than a reach with a higher CPUE (Nielsen and Johnson, 1983).

Four indices were generated to further assess the health of the fish communities found in these reaches. The Shannon Index (H') is a value that combines species richness and evenness where >3.99 can be considered non-impacted; 3.00-3.99, slightly impacted; 2.00-2.99, moderately impacted; and <2.00 , severely impacted (Bode and others, 1993). This calculation gives one estimate of the health of the entire fish community in each reach. A Jaccard Coefficient of Similarity and an Index of Similarity (Klemm and others, 1990) measure community similarity using the species present in both reaches and those found only in one reach or the other. These index scores can range between 0.0 and 1.0, reaching 1.0 as the similarities between reaches increases (Plafkin and others, 1989). The fourth index is an Index of Biotic Integrity (IBI). The Maryland IBI for non-coastal streams (Roth and others, 1997) was used because no IBI's have been developed for Pennsylvania and New York streams. The Maryland IBI was chosen because the fish fauna in that state's non-coastal streams are more like the fish fauna of Tioga County, Pa., than are the fauna of Ohio or the midwest, where IBI's have been developed. The IBI score is used to measure the health of a fish community taking into consideration the number of native species, feeding habitats of the species present, and their tolerance or intolerance to water pollution and sediment. The first two metrics for the IBI, number of native species and number of benthic species, are adjusted for watershed areas using the formula in Roth and others (1997). A numeric scale where 1.0-1.9 is very poor, 2.0-2.9 is poor, 3.0-3.9 is fair, and 4.0-5.0 is good (Roth and others, 1997) is used to show the health of the community. These indices in combination with the CPUE are used to show any differences between the fish communities in the reaches surveyed, to determine if the fish communities show any impairment, and to aid in assessing if differences seen in the communities are because of the dam.

When this work began, it was expected that a statewide IBI would be available by the time data analyses were initiated; however, this was not the case. Because the state of New York also did not have an IBI in place, the well researched and highly tested model developed by the Maryland Biological Stream Survey (MBSS) was selected. The use of regional IBI's has been endorsed by Miller and others (1988) and use of regional reference sites by Hughes and others (1986). These studies indicate that when geographically specific IBI's or reference conditions are not available, reasonably comparative conditions from ecologically similar areas may be used.

Although somewhat geographically distant, the fish faunal assemblages of Maryland were thought to better represent the Susquehanna River Basin drainage than the species depauperate northeastern region. The Northern Highland ecoregion is common to both the study area and the area for which the metrics were developed. Many metrics included in all multi-metric scoring systems seem to have 4-5 core metrics that explain most of the classification efficiency of the index. The remaining metrics add redundancy to ensure that a strong mathematical signal is developed. For example, 4 of the 12 metrics in the original IBI (Karr, 1981) are influenced by sediment.

The Maryland area where the IBI was developed may not be locally specific, but it does include a portion of the lower Susquehanna River drainage. The IBI also includes many sites, covers many species collected in the study area, and very importantly is adjusted for basin size. It is the logical alternative to use under these conditions.

FISH-COMMUNITY COMPOSITION

In the Tioga-Hammond Dam river system, the number of fish species identified at the 6 stream reaches surveyed ranged from 13 species at Mill Creek near Mansfield to 28 species at Tioga River near Tioga Junction (table 1). The dominant species in Mill Creek near Mansfield and Crooked Creek near Crooked Creek was blacknose dace. At Crooked Creek near Tioga, the dominant species was central stoneroller; at Tioga River at Tioga and Tioga River at Lindley, the banded darter was dominant. The bluntnose minnow was the dominant species at the Tioga River near Tioga Junction reach.

The fish communities upstream and downstream of the Tioga-Hammond Reservoirs except Mill Creek, had a Jaccard Coefficient of 0.50 or higher. All sites were below 0.50 when compared to Mill Creek. Mill Creek was less similar to the Crooked Creek and Tioga River sites than the Crooked Creek and Tioga River sites are to each other (table 2). Both Crooked Creek reaches were similar (table 2). Also, Crooked Creek near Tioga downstream of the Hammond Dam is similar to the Tioga River at Tioga just downstream of the Tioga Dam. Further downstream, more species were collected at Tioga River near Tioga Junction than at Tioga River at Tioga (table 1) or Crooked Creek near Tioga (table 1). Even with the number of species being different, the Tioga River reaches and the Crooked Creek reaches are similar. Species numbers increased in the Tioga River downstream of where Crooked Creek joins the river; the community composition, however, did not change significantly. Further downstream, at Tioga River at Lindley, fewer species were collected than at Tioga River near Tioga Junction, but the communities were still similar. The Tioga River upstream of the Tioga Dam was not sampled because of its history of acid mine drainage input (Ward, 1976) and inability to support fish life. Sampling in October 1998 by the COE still shows the river to be acidic (pH of 3.6) and devoid of fish life (K.P. Kulp, U.S. Army Corps of Engineers, written commun., 1999).

IBI, habitat, CPUE scores, and water-quality measurements were used to describe the fish communities present in the reaches. Fish communities in both Crooked Creek reaches, Tioga River near Tioga Junction, and Tioga River at Tioga were in good condition according to the IBI scores (table 3). Tioga River at Lindley was in fair condition (table 3). Habitat scores for the Crooked Creek and Tioga River reaches were all in the high sub-optimal range (table 4). CPUE scores ranged from 4.2 at Tioga River at Tioga to 17.0 at Crooked Creek near Tioga (table 1). Temperature (18-23°C), pH (6.8-7.5), and specific conductance (223-271 $\mu\text{S}/\text{cm}$) were similar for all reaches sampled including Mill Creek (see appendix). The IBI score at Mill Creek was 3.5, indicating the fish community was in fair condition (table 3). The habitat score (table 4) was in the sub-optimal range and was the same score as Tioga River near Tioga Junction and Tioga River at Lindley.

Mill Creek, which flows into Tioga Reservoir, differed from the other reaches surveyed. The Jaccard Coefficients for all reaches compared to Mill Creek ranged from 0.37 to 0.48 (table 2) and the Indexes of Similarity ranged from 0.53 to 0.65 (table 2). The Jaccards Coefficient between Mill Creek and Crooked Creek upstream of the dam was 0.48 and the Index of Similarity was 0.65. Mill Creek is different from Tioga River at Tioga; the Jaccard Coefficient was 0.37 and the Index of Similarity was 0.53. The community in Mill Creek had a Shannon Index of 2.57 (table 1) and Crooked Creek upstream of the reservoir had an index value of 2.56 (table 1). The CPUE in Mill Creek was 8.1 (table 1); Crooked Creek was 4.5 (table 1). The habitat score at Mill Creek was in the sub-optimal range as were all the other reaches (table 4). The Mill Creek fish community was in fair condition (table 3) but was composed of different species than in the other reaches.

Table 1. Taxa list, number of individuals, and total and average weights by species, total number of individuals, total number of species, catch-per-unit effort, and Shannon Index for fish communities upstream and downstream of the Tioga and Hammond Dams, Pa., 1998

[—, not collected in this sample]

Species name	Mill Creek near Mansfield			Crooked Creek near Crooked Creek			Crooked Creek near Tioga			Tioga River at Tioga			Tioga River near Tioga Junction			Tioga River at Lindley		
	Number of individuals	Species total weight in grams		Number of individuals	Species total weight in grams		Number of individuals	Species total weight in grams		Number of individuals	Species total weight in grams		Number of individuals	Species total weight in grams		Number of individuals	Species total weight in grams	
Central stoneroller, <i>Camposotoma anomalum</i>	41	149		2	7		274	1,376		23	408		77	807		2	14	
Satinfin shiner, <i>Cyprinella analostana</i>	—	—		—	—		—	—		1	3		—	—		—	—	
Spotfin shiner, <i>Cyprinella spiloptera</i>	—	—		31	44		4	17		—	—		17	40		12	14	
Common carp, <i>Cyprinus carpio</i>	1	1,345		2	1,898		2	9		1	799		1	649		—	—	
Cutlips minnow, <i>Exoglossum maxilllingua</i>	20	110		—	—		87	660		—	—		4	9		1	18	
River chub, <i>Nocomis micropogon</i>	17	82		—	—		—	—		57	264		25	440		14	73	
Comely shiner, <i>Notropis amoenus</i>	—	—		—	—		—	—		1	1		4	2		—	—	
Emerald shiner, <i>Notropis atherinoides</i>	—	—		—	—		1	1		—	—		—	—		—	—	
Spottail shiner, <i>Notropis hudsonius</i>	1	1		1	1		4	6		8	45		78	121		3	4	
Swallowtail shiner, <i>Notropis procne</i>	—	—		—	—		—	—		1	1		—	—		—	—	
Rosyface shiner, <i>Notropis rubellus</i>	—	—		—	—		—	—		—	—		1	2		—	—	
Bluntnose minnow, <i>Pimephales notatus</i>	—	—		52	106		200	422		9	33		248	416		85	135	
Blacknose dace, <i>Rhinichthys atratulus</i>	6	9		8	14		41	49		1	1		76	106		2	2	
Longnose dace, <i>Rhinichthys cataractae</i>	192	717		224	861		194	435		101	471		109	290		10	26	
Creek chub, <i>Semotilus atromaculatus</i>	—	—		—	—		8	40		1	7		4	16		—	—	
Fallfish, <i>Semotilus corporalis</i>	—	—		—	—		3	22		17	507		100	1,696		3	10	
White sucker, <i>Catostomus commersoni</i>	45	15,279		3	480		42	447		5	366		56	5,762		19	1,696	
Northern hog sucker, <i>Hypentelium nigricans</i>	—	—		1	97		1	3		2	41		15	1,016		3	117	
Yellow bullhead, <i>Ameiurus natalis</i>	—	—		1	127		8	70		5	48		10	837		5	78	

Table 1. Taxa list, number of individuals, and total and average weights by species, total number of individuals, total number of species, catch-per-unit effort, and Shannon Index for fish communities upstream and downstream of the Tioga and Hammond Dams, Pa., 1998—Continued

Species name	Mill Creek near Mansfield			Crooked Creek near Crooked Creek			Crooked Creek near Tioga			Tioga River at Tioga			Tioga River near Tioga Junction			Tioga River at Lindley		
	Number of individuals	Species total weight in grams		Number of individuals	Species total weight in grams		Number of individuals	Species total weight in grams		Number of individuals	Species total weight in grams		Number of individuals	Species total weight in grams		Number of individuals	Species total weight in grams	
Brown bullhead, <i>Ameiurus nebulosus</i>	1	68		—	—		—	—		—	—		1	69		—	—	
Margined madtom, <i>Noturus insignis</i>	39	237		35	216		205	1,228		19	163		28	109		67	362	
Chain pickerel, <i>Esox niger</i>	—	—		—	—		—	—		2	30		—	—		—	—	
Mottled sculpin, <i>Cottus bairdi</i>	11	57		29	184		—	—		—	—		—	—		—	—	
Sculpin, <i>Cottus spp.</i>	—	—		—	—		—	—		6	48		4	11		4	40	
Rock bass, <i>Ambloplites rupestris</i>	—	—		1	42		—	—		—	—		13	1,054		3	28	
Green sunfish, <i>Lepomis cyanellus</i>	—	—		4	47		—	—		3	22		2	30		—	—	
Pumpkinseed, <i>Lepomis gibbosus</i>	—	—		7	60		—	—		—	—		3	14		3	22	
Bluegill, <i>Lepomis macrochirus</i>	—	—		—	—		7	8		—	—		—	—		—	—	
Smallmouth bass, <i>Micropterus dolomieu</i>	28	1,671		2	36		1	6		4	40		19	1,131		1	17	
Black crappie, <i>Pomoxis nigromaculatus</i>	—	—		—	—		—	—		1	2		3	33		—	—	
Tessellated darter, <i>Etheostoma olmstedii</i>	6	11		99	173		243	455		4	5		72	122		182	383	
Banded darter, <i>Etheostoma zonale</i>	—	—		—	—		60	111		132	260		145	275		354	605	
Yellow perch, <i>Perca flavescens</i>	—	—		3	26		—	—		5	44		7	80		9	37	
Shield darter, <i>Percina peltata</i>	—	—		—	—		5	19		110	510		23	85		122	473	
Totals	408	19,736		305	4,419		1,390	5,384		519	4,119		1,145	15,222		904	4,154	
Total number of species	13			18			20			25			28			21		
CPUE (number of individuals per shocking time in minutes)	8.1			4.5			17.0			4.2			9.5			6.9		
H' (Shannon Index)	2.57			2.56			3.11			3.12			3.75			2.69		

Table 2. Jaccard Coefficient and Index of Similarity scores for fish communities upstream and downstream of the Tioga and Hammond Dams, Pa., 1998

Compared reach names	Jaccard Coefficient	Index of Similarity
Crooked Creek near Crooked Creek and Crooked Creek near Tioga	0.52	0.68
Crooked Creek near Crooked Creek and Tioga River at Tioga	.52	.65
Crooked Creek near Crooked Creek and Tioga River near Tioga Junction	.61	.74
Crooked Creek near Crooked Creek and Tioga River at Lindley	.54	.71
Crooked Creek near Tioga and Tioga River at Tioga	.55	.71
Crooked Creek near Tioga and Tioga River near Tioga Junction	.62	.75
Crooked Creek near Tioga and Tioga River at Lindley	.64	.78
Tioga River at Tioga and Tioga River near Tioga Junction	.71	.83
Tioga River at Tioga and Tioga River at Lindley	.60	.74
Tioga River near Tioga Junction and Tioga River at Lindley	.75	.86
Mill Creek near Mansfield and Crooked Creek near Crooked Creek	.48	.65
Mill Creek near Mansfield and Crooked Creek near Tioga	.42	.59
Mill Creek near Mansfield and Tioga River at Tioga	.37	.53
Mill Creek near Mansfield and Tioga River near Tioga Junction	.46	.63
Mill Creek near Mansfield and Tioga River at Lindley	.42	.59

Table 3. IBI score for fish communities upstream and downstream of the Tioga and Hammond Dams, Pa., 1998
[Scores: 4.0-5.0, good; 3.0-3.9, fair; 2.0-2.9, poor; 1.0-1.9, very poor]

IBI metric ¹	Mill Creek near Mansfield	Crooked Creek near Crooked Creek	Crooked Creek near Tioga	Tioga River at Tioga	Tioga River near Tioga Junction	Tioga River at Lindley
Number of native species (adjusted value)	3	5	5	5	5	5
Number of benthic species (adjusted value)	3	3	5	5	5	5
Percent tolerant individuals	5	5	5	5	5	5
Percent abundance of dominant species	5	3	5	5	5	5
Percent generalists, omnivores, and invertivores	3	5	3	3	3	1
Percent insectivores	3	5	5	5	3	5
Number of individuals per square meter	3	3	5	1	3	3
Percent lithophilic spawners	3	3	5	3	3	1
Average IBI score	3.5	4.0	4.8	4.0	4.0	3.8

¹ Roth and others, 1997.

Table 4. *Habitat assessment upstream and downstream of the Tioga and Hammond Dams, Pa., 1998*

[Scores: 0-5, poor; 6-10, marginal; 11-15, suboptimal; 16-20, optimal]

Habitat parameter ¹	Mill Creek near Mansfield	Crooked Creek near Crooked Creek	Crooked Creek near Tioga	Tioga River at Tioga	Tioga River near Tioga Junction	Tioga River at Lindley
Instream fish cover	18	14	17	10	15	12
Epifaunal substrate	18	13	19	16	14	14
Embeddedness	18	16	8	4	13	16
Velocity/depth regimes	18	18	15	15	18	17
Channel alteration	19	17	13	15	15	18
Sediment deposition	17	18	7	16	11	18
Frequency of riffles	17	14	19	15	13	15
Channel flow status	14	13	16	17	16	17
Condition of banks	10	8	16	18	17	16
Bank vegetative protection	6	12	16	18	18	15
Grazing or other disruptive pressure	17	15	13	16	17	18
Riparian vegetative zone width	12	17	12	12	13	10
Total score	184	174	171	172	180	186
Average score	15	14	14	14	15	15

¹ Klemm and Lazorchak, 1995.

The community differences seen between Mill Creek and Crooked Creek upstream of the reservoirs are in the number of species present in each stream, 13 and 18, respectively, and the species themselves (10 common species). The three species in Mill Creek and not Crooked Creek were cutlips minnow, river chub, and brown bullhead (table 1). These species need little to no vegetation for cover, are typical in pools of clear water streams, and are commonly in creeks with boulder and gravel stream bottoms (Cooper, 1983; Jenkins and Burkhead, 1994; Page and Burr, 1991; Rohde and others, 1994; Smith, 1985). The species in Crooked Creek and not Mill Creek were spotfin shiner, bluntnose minnow, northern hog sucker, yellow bullhead, rockbass, green sunfish, pumpkinseed, and yellow perch (table 1). These species are typical in clear water streams where vegetation, pools, and sluggish flowing waters are present and the stream bottom is boulder, gravel, and sand (Cooper, 1983; Jenkins and Burkhead, 1994; Page and Burr, 1991; Rohde and others, 1994; Smith, 1985). The instream habitat appears to be different in the two streams and is reflected in the fish communities present in these reaches.

The fish communities in the reaches flowing in and out of the Tioga-Hammond Reservoirs appear to be in fair to good condition. External anomalies included blackspot, parasites, and lesions, but these were minimal in all reaches (see appendix). These three anomalies show an inconsistent relation with water quality and are therefore recorded but not used in assessments of water quality but can be used to show fish health (Sanders and others, 1999). Fin erosion was the most noted anomaly at the Lindley site but affected only a small percentage of the total fish collected in this reach. Fin erosion is usually a clinical sign for possible bacterial infections (Nielson and Johnson, 1983; Sanders and others, 1999).

Habitat is sub-optimal for all reaches sampled in this survey. Even though the range is similar, the habitats are different and these differences are reflected in the community compositions found in each reach. The communities increase in number of species collected as Crooked Creek flows into the Tioga River. In the Tioga River near Tioga Junction reach just below the inflow of Crooked Creek, 28 species were collected. Further downstream, 21 species were collected in the Tioga River at Lindley reach. Species collected in Crooked Creek and not in the Tioga River at Lindley reach were carp, emerald shiner, and creek chub. These species are typically collected in riffle and run areas. Species gained in the Tioga River at Lindley reach were river chub, sculpin, rock bass, pumpkinseed, and yellow perch and, except for sculpin, are typically collected in deeper pools and around vegetation and woody snags (Cooper, 1983; Page and Burr, 1991; Rohde and others, 1994). Sculpin are found in riffle areas where the water is flowing and not sluggish as it is in pooled areas of the stream (Page and Burr, 1991; Rohde and others, 1994). This reach contained areas of fast riffles where the three sculpin could have been collected.

The Cowanesque River also enters the Tioga River before the Lindley site and downstream of the confluence with Crooked Creek. To assess the influence of the Cowanesque River on the Tioga River, the Tioga River near Tioga Junction and Tioga River at Lindley reaches were compared. These reaches were very similar with a Jaccard Coefficient of 0.75 (table 2). All the fish species collected in the Lindley reach also were collected in the Tioga Junction reach. It does not appear that the Cowanesque River adds new species to the Lindley reach because the Tioga River at Tioga Junction reach is more diverse than the Tioga River at Lindley reach and no new species were collected at Lindley. The added water from the Cowanesque River could explain habitat differences between Crooked Creek and Tioga River at Lindley but the fish communities are still similar. Slight community shifts were seen as surveys moved further downstream of the dam; however, the majority of species collected in the Lindley site also were collected in Crooked Creek near Tioga.

The Hammond Dam does not appear to have had a significant effect on the fish communities in Crooked Creek in the reaches that were surveyed. IBI scores indicate that the fish communities are in good health. Specific conductance and temperature were not highly variable between the reaches and the pH was close to 7. Habitat scored on the high end of the sub-optimal range.

Effects of the Tioga Dam cannot be directly determined because of the lack of a sampling reach on Tioga River upstream of the dam. Historically, the Tioga River upstream of the dam has had no fish life (Ward, 1976). The Tioga River upstream of the dam is affected by acid mine drainage and few to no macroinvertebrates or fish were found in this reach when a survey was conducted by the U.S. Army Corps of Engineers in October 1998 (K.P. Kulp, U.S. Army Corps of Engineers, written commun., 1999). Preimpoundment studies showed the river to have a pH of 5.6, which is too low to support a healthy fish population (Ward, 1976) typically seen in this area. The pH becomes more neutral in the Tioga River downstream of the dam. It appears the reservoir has mitigated the effect of mine drainage and raised the pH of the water downstream of the dam. Mill Creek and Hammond Reservoir add water to the Tioga Reservoir. These inputs may help raise the pH of the water and dilute metals associated with the acid mine drainage before the water flows out of the Tioga Dam. Dams typically trap coarse and fine particulate organic matter, allow time for suspended solids to settle out of the water, and clarify the water before it is released to the downstream part of the stream (Symons and others, 1964; Vannote and others, 1980).

The fish communities present downstream of the Tioga Dam are similar to those of Crooked Creek. It is possible the species of the Tioga River downstream of the dam migrated there from Crooked Creek and filled niches in the Tioga River that became more habitable after the dam was constructed and waters were clarified by the retention time in the reservoir. Historical data show that eight fish species were collected in the Tioga Junction reach prior to the construction of the dam (Ward, 1976). The number of species collected in the Tioga Junction reach in 1998 was 28. Further research into historical data would be needed to show the fish-community changes that have taken place in these streams since the construction of the dams.

SUMMARY

The purpose of studying Mill and Crooked Creeks and the Tioga River, which flow in and out of the Tioga-Hammond Reservoirs, was to evaluate the current status of fish communities in the vicinity of the dams. The intent was to determine if the communities above and below the reservoir are similar or different and to comment on the health of the communities present in each reach.

On the basis of calculated IBI scores, the fish communities are in fair to good condition in all the reaches. The fish communities in Crooked Creek near Crooked Creek, Crooked Creek near Tioga, Tioga River at Tioga, and Tioga River near Tioga Junction were categorized as being in good condition (IBI scores ranged from 4.0 to 4.8). Mill Creek near Mansfield and Tioga River at Lindley fish communities were categorized as being in fair condition; IBI scores were 3.5 and 3.8, respectively. The habitats at all six reaches were sub-optimal yet different, which was reflected in the species of each fish community present in these reaches.

The fish communities of Crooked Creek upstream and downstream of the Hammond Dam were similar, with a Jaccards Coefficient of 0.52 and a Index of Similarity of 0.68. These communities also were similar to those communities surveyed in the three reaches downstream of the Tioga Dam. The fish community in the Mill Creek reach upstream of the Tioga Dam was not similar to the five other reaches sampled. The Jaccard Coefficients ranged from 0.37 to 0.48 and the Index of Similarities ranged from 0.53 to 0.65.

The fish communities below the Tioga Dam are similar to those in Crooked Creek. The Tioga River upstream of the dam is affected by acid mine drainage, and few to no macroinvertebrates and fish are present in the river. Yet below the dam, the river is able to support fish communities. Mill Creek also is able to support fish communities and is not affected by acid mine drainage. The fish communities in Mill Creek are not similar to those of the other reaches. It is possible the communities in the Tioga River downstream of the dam have come into the river from the other creeks and rivers that enter the Tioga River and are able to exist because of better water quality downstream of the dam.

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APPENDIX

Study Unit: COE
Station Name: Mill Creek near Mansfield, Pa.
Lat/Long: 41°52'24"77°05'03"
County: Tioga
pH: 6.8, **Temperature:** 23°C, **Conductance:** 234 µS/cm
Investigators: Bilger, Brightbill, Kulp, Barlock

Date of Collection: 09/14/1998
of Species at Reach: 13
Sampling Gear Code: backpack electroshocker
Time/Pass(sec./min.): 3,036/50.6

Species name	Total number of fish per species	Percent of total number of fish	Total weight per species (grams)	Percent total weight	Average weight (grams)	Range of weights (grams)	Average total length (millimeters)	Range of total lengths (millimeters)	Average standard length (millimeters)	Range of standard lengths (millimeters)
Central stoneroller, <i>Camposoma anomalum</i>	41	10.0	149	0.755	4	1-20	67	46-117	54	36-97
Common carp, <i>Cyprinus carpio</i>	1	.2	1,345	6.81	1,345	1,345	480	480	390	390
Cutlips minnow, <i>Exoglossum maxillingua</i>	20	4.9	110	.557	6	2-14	71	45-101	58	35-83
River chub, <i>Nocomis micropogon</i>	17	4.2	82	.415	5	2-25	67	48-129	544	37-106
Spottail shiner, <i>Notropis hudsonius</i>	1	.2	1	.005	1	1	46	46	40	40
Blacknose dace, <i>Rhinichthys atratulus</i>	6	1.5	9	.046	2	1-3	47	39-61	37	29-50
Longnose dace, <i>Rhinichthys cataractae</i>	192	47.1	717	3.63	4	1-7	69	44-90	56	34-74
White sucker, <i>Catostomus commersoni</i>	45	11.0	15,279	77.4	340	5-622	305	130-397	250	105-330
Brown bullhead, <i>Ameiurus nebulosus</i>	1	.2	68	.344	68	68	161	161	136	136
Margined madtom, <i>Noturus insignis</i>	39	9.6	237	1.20	6	1-20	81	45-134	65	35-110
Mottled sculpin, <i>Cottus bairdi</i>	11	2.7	57	.289	5	2-7	65	41-75	50	30-60
Smallmouth bass, <i>Micropterus dolomieu</i>	28	6.9	1,671	8.47	60	4-231	137	62-254	111	50-205
Tessellated darter, <i>Etheostoma olmstedti</i>	6	1.5	11	.056	2	1-3	53	39-69	42	29-55
Totals for reach:	408		19,736							

Reported anomalies: central stoneroller - 8% with blackspot; cutlips minnow - 5% with lesions; river chub - 24% with blackspot; longnose dace - 8% with blackspot; white sucker - 4% with blackspot; margined madtom - 8% with parasites; smallmouth bass - 44% with leeches.

Study Unit: COE
 Station Name: Crooked Creek near Crooked Creek, Pa.
 Lat/Long: 41°52'21"77°12'30"
 County: Tioga
 pH: 7.1, Temperature: 23°C, Conductance: 271 µS/cm
 Investigators: Bilger, Brightbill, Kulp, Jones

Date of Collection: 09/21/1998
 # of Species at Reach: 18
 Sampling Gear Code: backpack electroshocker
 Time/Pass(sec./min.): 4,086/68.1

[—, data not recorded]

Species name	Total number of fish per species	Percent of total number of fish	Total weight per species (grams)	Percent total weight	Average weight (grams)	Range of weights (grams)	Average total length (millimeters)	Range of total lengths (millimeters)	Average standard length (millimeters)	Range of standard lengths (millimeters)
Central stoneroller, <i>Camposoma anomalum</i>	2	0.4	7	0.158	4	3-4	67	65-69	53	51-55
Spotfin shiner, <i>Cyprinella spiloptera</i>	31	6.1	44	.996	1	1-7	39	20-87	—	—
Common carp, <i>Cyprinus carpio</i>	2	.4	1,898	42.9	949	657-1,241	431	391-471	337	300-375
Spottail shiner, <i>Notropis hudsonius</i>	1	.2	1	.023	1	1	27	27	—	—
Bluntnose minnow, <i>Pimephales notatus</i>	52	10.3	106	2.39	2	1-5	52	26-77	43	20-61
Blacknose dace, <i>Rhinichthys atratulus</i>	8	1.6	14	.317	2	1-3	52	42-62	41	32-50
Longnose dace, <i>Rhinichthys cataractae</i>	224	44.4	861	19.5	4	1-9	64	40-96	50	30-77
White sucker, <i>Catostomus commersoni</i>	3	.6	480	10.9	240	61-216	244	183-280	198	145-225
Northern hog sucker, <i>Hypentelium nigricans</i>	1	.2	97	2.19	97	97	207	207	165	165
Yellow bullhead, <i>Amiurus natalis</i>	1	.2	127	2.87	127	127	205	205	175	175
Margined madtom, <i>Noturus insignis</i>	35	6.9	216	4.89	9	1-17	71	40-132	60	31-115
Mottled Sculpin, <i>Cottus bairdi</i>	29	5.7	184	4.16	6	4-10	72	60-84	57	47-67
Rockbass, <i>Ambloplites rupestris</i>	1	.2	42	.950	42	42	130	130	105	105
Green sunfish, <i>Lepomis cyanellus</i>	4	.8	47	1.06	12	4-20	78	56-99	62	44-79
Pumpkinseed, <i>Lepomis gibbosus</i>	7	1.4	60	1.36	9	5-15	73	60-90	56	47-70
Smallmouth bass, <i>Micropterus dolomieu</i>	2	.4	36	.815	18	10-26	103	80-125	85	69-100
Tessellated darter, <i>Etheostoma olmstedii</i>	99	19.6	173	3.91	2	1-4	54	43-69	43	35-55
Yellow perch, <i>Perca flavescens</i>	3	.6	26	.588	9	7-11	100	90-116	80	74-90
Totals for site:	505		4,419							

Reported anomalies: pumpkinseed - 29% with blackspot.

Study Unit: COE
 Station Name: Crooked Creek near Tioga, Pa.
 Lat/Long: 41°54'32"77°08'27"
 County: Tioga
 pH: 7.2, Temperature: 19°C, Conductance: 223 µS/cm
 Investigators: Bilger, Brightbill, Kulp, Pisarski, Barlock

Date of Collection: 09/17/1998
 # of Species at Reach: 20
 Sampling Gear Code: backpack electroshocker
 Time/Pass(sec./min.): 4,895/81.6

[—, data not recorded]

Species name	Total number of fish per species	Percent of total number of fish	Total weight per species (grams)	Percent total weight	Average weight (grams)	Range of weights (grams)	Average total length (millimeters)	Range of total lengths (millimeters)	Average standard length (millimeters)	Range of standard lengths (millimeters)
Central stoneroller, <i>Camposoma anomalum</i>	274	19.7	1,376	25.6	5	2-15	78	55-113	63	45-92
Spotfin shiner, <i>Cyprinella spiloptera</i>	4	.3	17	.316	4	2-6	76	66-85	63	60-66
Common carp, <i>Cyprinus carpio</i>	2	.1	9	.167	4	4-5	63	60-67	47	45-50
Cutlips minnow, <i>Exoglossum maxillingua</i>	87	6.3	660	12.3	8	1-18	70	41-118	56	30-96
Emerald shiner, <i>Notropis atherinoides</i>	1	.1	1	.019	1	1	41	41	—	—
Spottail shiner, <i>Notropis hudsonius</i>	4	.3	6	.111	2	1-2	54	51-56	—	—
Bluntnose minnow, <i>Pimephales notatus</i>	200	14.4	422	7.84	2	1-6	58	30-82	47	24-66
Blacknose dace, <i>Rhinichthys atratulus</i>	41	2.9	49	.910	1	1-2	45	35-57	36	25-45
Longnose dace, <i>Rhinichthys cataractae</i>	194	14.0	435	8.08	2	108	65	43-91	52	32-74
Creek chub, <i>Semotilus atromaculatus</i>	8	.6	40	.743	5	2-10	73	60-97	19	39-79
Fallfish, <i>Semotilus corporalis</i>	3	.2	22	.409	7	3-16	81	60-122	—	—
White sucker, <i>Catostomus commersoni</i>	42	3.0	447	8.30	11	6-14	91	80-101	71	60-81
Northern hog sucker, <i>Hypentelium nigricans</i>	1	.1	3	.056	3	3	62	62	49	49
Yellow bullhead, <i>Amiurus natalis</i>	8	.6	70	1.30	9	2-54	67	42-155	55	34-130
Margined madtom, <i>Noturus insignis</i>	205	14.7	1,228	22.8	6	1-16	79	32-125	65	25-107
Bluegill, <i>Lepomis macrochirus</i>	7	.5	8	.149	1	1-2	34	27-50	26	19-38
Smallmouth bass, <i>Micropterus dolomieu</i>	1	.1	6	.111	6	6	70	70	57	57
Tessellated darter, <i>Etheostoma olmstedii</i>	243	17.5	455	8.45	2	1-3	56	45-67	44	34-54
Banded darter, <i>Etheostoma zonale</i>	60	4.3	111	2.06	2	1-3	50	37-58	40	27-46
Shield darter, <i>Percina peltata</i>	5	.4	19	.353	4	3-4	70	64-74	56	49-60
Totals for site:	1,390		5,384							

Reported anomalies: central stoneroller - 12% with blackspot; white sucker - 4% with blackspot; yellow bullhead - 13% with lesions.

Study Unit: COE
Station Name: Tioga River at Tioga, Pa.
Lat/Long: 41°54'37"77°07'48"
County: Tioga
pH: 6.8, **Temperature:** 19°C, **Conductance:** 264 µS/cm
Investigators: Bilger, Brightbill, Kulp, Pisarski, Jones

Date of Collection: 09/23/1998
of Species at Reach: 25
Sampling Gear Code: backpack electroshocker
Time/Pass(sec./min.): 7,476/125

Species name	Total number of fish per species	Percent of total number of fish	Total weight per species (grams)	Percent total weight	Average weight (grams)	Range of weights (grams)	Average total length (millimeters)	Range of total lengths (millimeters)	Average standard length (millimeters)	Range of standard lengths (millimeters)
Central stoneroller, <i>Campostoma anomidum</i>	23	4.4	408	9.91	18	8-37	109	87-144	90	70-120
Satinfin shiner, <i>Cyprinella analostana</i>	1	.2	3	.073	3	3	73	73	58	58
Common carp, <i>Cyprinus carpio</i>	1	.2	799	19.4	799	799	404	404	310	310
River chub, <i>Nocomis micropogon</i>	57	11.0	264	6.41	5	1-31	66	25-143	54	18-115
Comely shiner, <i>Notropis amoenus</i>	1	.2	1	.024	1	1	50	50	41	41
Spottail shiner, <i>Notropis hudsonius</i>	8	1.5	45	1.09	6	3-8	90	71-102	74	58-82
Swallowtail shiner, <i>Notropis procne</i>	1	.2	1	.024	1	1	48	48	38	38
Bluntnose minnow, <i>Pimephales notatus</i>	9	1.7	33	.801	4	1-10	62	35-85	49	26-70
Blacknose dace, <i>Rhinichthys atratulus</i>	1	.2	1	.024	1	1	42	42	32	32
Longnose dace, <i>Rhinichthys cataractae</i>	101	19.5	471	11.4	5	1-10	71	43-92	58	35-80
Creek chub, <i>Semotilus atromaculatus</i>	1	.2	7	.170	7	7	87	87	70	70
Fallfish, <i>Semotilus corporalis</i>	17	3.3	507	12.3	30	2-114	124	63-239	109	59-195
White sucker, <i>Catostomus commersoni</i>	5	1.0	366	8.88	73	56-79	192	172-200	152	139-160
Northern hog sucker, <i>Hypentelium nigricans</i>	2	.4	41	.995	20	16-25	128	120-137	102	95-109
Yellow bullhead, <i>Ameiurus natalis</i>	5	1.0	48	1.17	10	6-16	914	79-110	76	67-90
Margined madtom, <i>Noturus insignis</i>	19	3.7	163	3.96	9	3-16	103	86-127	88	75-102
Chain pickerel, <i>Esox niger</i>	2	.4	30	.728	15	11-19	145	130-160	122	110-134
Sculpin, <i>Cottus spp</i>	6	1.2	48	1.17	8	3-15	80	65-97	65	51-80
Green sunfish, <i>Lepomis cyanellus</i>	3	.6	22	.534	7	7-8	70	65-74	54	50-57
Smallmouth bass, <i>Micropterus dolomieu</i>	4	.8	40	.971	10	5-24	85	70-120	68	56-95
Black crappie, <i>Pomoxis nigromaculatus</i>	1	.2	2	.048	2	2	53	53	41	41
Tessellated darter, <i>Etheostoma olmstedii</i>	4	.8	5	.121	1	1-2	53	50-60	42	39-47
Banded darter, <i>Etheostoma zonale</i>	132	25.4	260	6.31	2	1-3	50	40-60	40	32-50
Yellow perch, <i>Perca flavescens</i>	5	1.0	44	1.06	9	5-19	93	83-125	74	66-100
Shield darter, <i>Percina peltata</i>	110	21.2	510	12.4	5	2-8	72	65-86	60	54-71
Totals for site:	519		4,119							

Reported anomalies: margined madtoms - 10% with parasites.

Study Unit: COE
Station Name: Tioga River near Tioga Junction, Pa.
Lat/Long: 41°57'26"77°06'56"
County: Tioga
pH: 6.8, Temperature: 18°C, Conductance: 266 µS/cm
Investigators: Bilger, Brightbill, Kulp, Pisarski, Jones

Date of Collection: 09/24/1998
of Species at Reach: 28
Sampling Gear Code: backpack electroshocker
Time/Pass(sec./min.): 7,181/120

[—, data not recorded]

Species name	Total number of fish per species	Percent of total number of fish	Total weight per species (grams)	Percent total weight	Average weight (grams)	Range of weights (grams)	Average total length (millimeters)	Range of total lengths (millimeters)	Average standard length (millimeters)	Range of standard lengths (millimeters)
Central stoneroller, <i>Camposostoma anomalum</i>	77	6.7	807	5.30	10	2-39	81	50-139	67	40-120
Spotfin shiner, <i>Cyprinella spiloptera</i>	17	1.5	40	.263	2	1-6	64	37-87	—	—
Common carp, <i>Cyprinus carpio</i>	1	.1	649	4.26	649	649	370	370	303	303
Cutlips minnow, <i>Exoglossum maxillaria</i>	4	.3	9	.059	2	2-3	47	42-52	38	34-41
River chub, <i>Nocomis biguttatus</i>	25	2.2	440	2.89	18	1-77	83	38-185	68	29-152
Comely shiner, <i>Notropis atherinoides</i>	4	.3	2	.013	1	.5	39	37-41	—	—
Spottail shiner, <i>Notropis hudsonius</i>	78	6.8	121	.795	2	1-6	57	24-93	—	—
Rosyface shiner, <i>Notropis rubellus</i>	1	.1	2	.013	2	2	76	76	—	—
Bluntnose minnow, <i>Pimephales notatus</i>	248	21.7	416	2.73	2	1-6	53	32-85	43	25-70
Blacknose dace, <i>Rhinichthys atratulus</i>	76	6.6	106	.696	1	1-4	51	40-65	41	30-52
Longnose dace, <i>Rhinichthys cataractae</i>	109	9.5	290	1.90	3	1-11	61	42-92	48	32-75
Creek chub, <i>Semotilus atromaculatus</i>	4	.3	16	.105	4	2-9	68	56-96	55	45-77
Fallfish, <i>Semotilus corporalis</i>	100	8.7	1,696	11.1	17	8-104	154	101-227	117	90-180
White sucker, <i>Catostomus commersoni</i>	56	4.9	5,762	37.9	103	40-742	221	148-409	180	120-340
Northern hog sucker, <i>Hypentelium nigricans</i>	15	1.3	1,016	6.67	68	23-362	174	131-390	139	109-255
Yellow bullhead, <i>Ameiurus natalis</i>	10	.9	837	5.49	84	1-247	160	40-240	136	30-210
Brown bullhead, <i>Ameiurus nebulosus</i>	1	.1	69	.453	69	69	173	173	145	145
Margined madtom, <i>Noturus insignis</i>	28	2.4	109	.716	4	1-12	69	40-106	59	35-90
Sculpin, <i>Cottus spp</i>	4	.3	11	.072	3	1-6	51	41-70	41	34-55
Rockbass, <i>Ambloplites rupestris</i>	13	1.1	1,054	6.92	81	10-253	140	80-225	111	60-180
Green sunfish, <i>Lepomis cyanellus</i>	2	.2	30	.197	15	13-17	72	69-76	92	87-96
Pumpkinseed, <i>Lepomis gibbosus</i>	3	.3	14	.092	5	4-6	61	55-65	47	40-52
Smallmouth bass, <i>Micropterus dolomieu</i>	19	1.7	1,131	7.43	59	2-263	147	55-275	116	42-220
Black crappie, <i>Pomoxis nigromaculatus</i>	3	.3	33	.217	11	9-14	92	85-100	72	65-80
Tessellated darter, <i>Etheostoma olmstedii</i>	72	6.3	122	.801	2	1-3	54	46-69	43	30-55
Banded darter, <i>Etheostoma zonale</i>	145	12.7	275	1.81	2	1-3	48	32-60	38	24-49
Yellow perch, <i>Perca flavescens</i>	7	.6	80	.526	11.4	6-25	102	86-135	83	69-110
Shield darter, <i>Perca peltata</i>	23	2.0	85	.558	3.7	2-5	69	55-75	57	45-63
Totals for site:	1,145		15,222							

Reported anomalies: yellow bullhead - 10% with lesions.

Study Unit: COE
Station Name: Tioga River at Lindley, NY.
Lat/Long: 42°01'23"77°07'53"
County: Tioga
pH: 7.5. **Temperature:** 20°C. **Conductance:** 236 µS/cm
Investigators: Bilger, Brightbill, Kulp, Pisarski, Jones

Date of Collection: 09/22/1998
of Species at Reach: 21
Sampling Gear Code: backpack electroshocker
Time/Pass(sec./min.): 7,885/131

[—, data not recorded]

Species name	Total number of fish per species	Percent of total number of fish	Total weight per species (grams)	Percent total weight	Average weight (grams)	Range of weights (grams)	Average total length (millimeters)	Range of total lengths (millimeters)	Average standard length (millimeters)	Range of standard lengths (millimeters)
Central stoneroller, <i>Camptostoma anomalum</i>	2	0.2	14	0.337	7.0	7	85	75-96	70	60-80
Spotfin shiner, <i>Cyprinella spiloptera</i>	12	1.3	14	.337	1.2	1-3	38	29-71	—	—
Cutlips minnow, <i>Exoglossum maxillingua</i>	1	.1	18	.433	18.0	18	110	110	90	90
River chub, <i>Nocomis micropogon</i>	14	1.5	73	1.76	5.2	1-52	59	40-173	—	—
Spottail shiner, <i>Notropis hudsonius</i>	3	.3	4	.096	1.3	1-2	53	52-55	—	—
Bluntnose minnow, <i>Pimephales notatus</i>	85	9.4	135	3.25	1.6	1-6	50	28-80	41	22-66
Blacknose dace, <i>Rhinichthys atratulus</i>	2	.2	2	.048	1.0	1	39	38-39	32	30-33
Longnose dace, <i>Rhinichthys cataractae</i>	10	1.1	26	.626	2.6	1-6	63	49-92	50	39-65
Fallfish, <i>Semotilus corporalis</i>	3	.3	10	.241	3.3	3-4	70	67-72	—	—
White sucker, <i>Catostomus commersoni</i>	19	2.1	1,696	40.8	89.3	11-188	192	99-251	152	80-202
Northern hog sucker, <i>Hypentelium nigricans</i>	3	.3	117	2.82	39.0	3-70	140	71-191	111	55-150
Yellow bullhead, <i>Ameiurus natalis</i>	5	.6	78	1.88	15.6	6-53	87	66-158	73	53-138
Margined madtom, <i>Noturus insignis</i>	67	7.4	362	8.71	5.4	1-19	66	38-135	54	32-110
Sculpin, <i>Cottus spp</i>	4	.4	40	.963	10.0	5-14	86	72-93	69	60-75
Rockbass, <i>Ambloplites rupestris</i>	3	.3	28	.674	9.3	8-11	76	70-81	60	55-63
Pumpkinseed, <i>Lepomis gibbosus</i>	3	.3	22	.530	7.3	6-9	76	72-78	59	55-61
Smallmouth bass, <i>Micropterus dolomieu</i>	1	.1	17	.409	17.0	17	112	112	89	89
Tessellated darter, <i>Etheostoma olmstedii</i>	182	20.1	383	9.22	2.1	1-4	51	31-67	42	26-54
Banded darter, <i>Etheostoma zonale</i>	354	39.2	605	14.6	1.7	1-3	46	31-59	38	27-50
Yellow perch, <i>Percina flavescens</i>	9	1.0	37	.891	4.1	1-25	74	58-141	60	46-114
Shield darter, <i>Percina peltata</i>	122	13.5	473	11.3	3.8	1-8	70	48-75	57	40-67
Totals for site:	904		4,154							

Reported anomalies: central stoneroller - 50% with fin erosion; river chub - 7% with fin erosion, 7% with leeches; bluntnose minnow - 16% with fin erosion; longnose dace - 22% with fin erosion; tessellated darter - 28% with leeches, 8% with fin erosion; banded darter - 4% with fin erosion.